University of San Diego
OFFICE OF UNDERGRADUATE RESEARCH


# CREATIVE COLLABORATIONS

## A CELEBRATION OF STUDENT-FACULTY WORKS

**APRIL 28 & APRIL 30, 2026**

**12:15 PM - 2:15 PM**

**LEARNING COMMONS TOWN SQUARE**

**STUDENT-FACULTY**
**RESEARCH**
**SCHOLARSHIP**
**CREATIVE WORKS**

Welcome to the 2026 Creative Collaborations showcase!

This is the 36th year of showcasing undergraduate research at the University of San Diego! Undergraduate research conferences at USD have had a long and rich history, dating back to the first one in 1990, led by Dr. Marie Simovich of the Department of Biology. At the time, the annual showcase was called the Undergraduate and Internship Conference. What began with about 20 science students quickly grew across the years to incorporate student research and scholarly work of many other disciplines. In 2006, the showcase was renamed to Creative Collaborations, led by Dr. Tammy Dwyer of the Department of Chemistry and Biochemistry, as the conference continued to integrate across different disciplines, celebrating the collaborative spirit between students and their faculty mentors.

More than ever, across the nation, we’re seeing the involvement of undergraduates in the research enterprise. There is evidence that undergraduate research works on multiple fronts, especially as a high-impact, transformative experience for students. Students not only learn technical skills in doing research or conducting other scholarly and creative works, but they receive mentorship from their faculty who are deeply invested in them. Faculty benefit from the new and exciting ideas contributed by the next generation, and the university benefits by putting this next generation at the forefront of research and discovery. Here at USD, under the thoughtful guidance of world-class faculty, students get to be in the driver’s seat—not just passive learners in the traditional classroom, but actual creators of new knowledge in STEM, social sciences, humanities, and creative works.

This year’s showcase immediately follows “Undergraduate Research Week” as designated by the Council on Undergraduate Research (CUR). Since 2011, the U.S. House of Representatives has declared a week in April to commemorate undergraduate research, and CUR has followed this annual tradition. USD is proud to be part of this national celebration through Creative Collaborations. With 48 presentations this year, the PechaKucha format features a highly interactive and engaging array of lightning talks that highlights the broad and diverse topics of undergraduate research at USD. There will be opportunities for the audience to submit questions to student presenters and vote for their favorite presentations!

Congratulations to all our student presenters and their faculty mentors in bringing Creative Collaborations to life this year, and thank you all for celebrating undergraduate research with us!

Sincerely,

Cawa Tran, PhD
Associate Professor of Biology
Directory for Undergraduate Research

## TUESDAY, APRIL 28, 2026

**SESSION 1 (12:20 PM - 1:15 PM)**

1. **Irianna Morales** (Psychological Sciences)
2. **Tatum Mosley** (Political Science and International Relations)
3. **JB Barrientos** (Art, Architecture, and Art History)
4. **Sandra Santos** (Art, Architecture, and Art History)
5. **Daisy Morales-Zaragoza** (Art, Architecture, and Art History)
6. **Dimitra Protopapas** (Physics and Biophysics)
7. **Emma Mozalova** (Neuroscience, Cognition and Behavior)
8. **Yadira Dominguez** (Biology)
9. **Chloe Howel** (Psychological Sciences)
10. **Luke Blatney** (Psychological Sciences)

**SESSION 2 (1:15 PM - 2:15 PM)**

11. **Camille Van Bruaene** (History)
12. **Madison Harkin** (English)
13. **Jack DeVries** (Theology and Religious Studies)
14. **Eleanor Soininen** (Philosophy)
15. **Carly Senteno** (English)
16. **Gianna Eaton** (History)
17. **Agniya Seliuzhytskaya** (Art, Architecture, and Art History)
18. **Bre'Arra Long** (Political Science and International Relations)
19. **Cherishann Diamzon, Kaitlin Trauscht** (Communication)
20. **Alaya Chapa** (Biology)
21. **Daivion Terry** (Chemistry and Biochemistry)
22. **Franki Flores** (Chemistry and Biochemistry)
23. **Samantha Luna** (Neuroscience, Cognition and Behavior)

## THURSDAY, APRIL 30, 2026

**SESSION 1 (12:20 PM - 1:15 PM)**

24. **Vivien Papp** (Integrated Engineering)
25. **Caroline Nasiak, Eva Kascak** (Mathematics)
26. **Bridget McFall** (Biology)
27. **Adrianna Galvan** (Physics and Biophysics)
28. **Judith Garcia Leon** (Chemistry and Biochemistry)
29. **Geraldin Ramirez Velazquez** (Physics and Biophysics)
30. **Claire Sheerin, Yaron Guberman, Sophia Stark** (Psychological Sciences)
31. **Arianna Hahn** (Psychological Sciences)
32. **Briana Burton** (Art, Architecture, and Art History; University Operations & Facilities Management)
33. **Christian Rincon, Anthony Romo** (Physics and Biophysics)
34. **Vera Maaskant** (Neuroscience, Cognition and Behavior)
35. **Josiah Lee, Nick Narloch, Samarah Azzi** (Chemistry and Biochemistry)

**SESSION 2 (1:15 PM - 2:15 PM)**

36. **Brynn Gerty, Alyssa Robertson, Caroline Mahoney, Gavriella Graves, Colette Patterson** (Integrated Engineering)
37. **Michael Rosalia** (Computer Science)
38. **Sara Teferi** (Computer Science)
39. **Jonathan Martin** (Chemistry and Biochemistry)
40. **Arlene Garcia Guzman** (Art, Architecture, and Art History)
41. **Isabella Reynolds** (Ethnic Studies)
42. **Abigail McDowell** (Chemistry and Biochemistry)
43. **Rebecca Albracht** (Chemistry and Biochemistry)
44. **Stella Osman** (Chemistry and Biochemistry)
45. **Kate Flaherty, Rose Seaver, Turner Grubbs** (Mechanical Engineering)
46. **Patrick Matthews** (Mechanical Engineering)
47. **Jacob Ramirez** (Mechanical Engineering)
48. **Makan Ahadian** (Industrial and Systems Engineering)

# TUESDAY, APRIL 28, 2026

## SESSION 1 (12:15 PM - 1:15 PM)

### Intergenerational Households and Mental Health in Filipino American Young Adults

Irianna Morales and Steven Berkley

Intergenerational households create a distinct environment in which child rearing involves grandparents. Filipino culture places an emphasis on family and respect for elders, which makes intergenerational living common, and these values may encourage or discourage individuals from seeking mental health support. This study explores the formative role that intergenerational households play in the behavioral and socioemotional development of Filipino young adults, and whether it influences intergenerational cultural conflict or provides encouragement regarding mental health sentiments. Using an online survey administered to Filipino American young adults (18-25 years old) in California who experienced living in an intergenerational household, the present study measures intergenerational family conflict in Filipino families, grandparent importance, and mental health-seeking attitudes. This study addresses the gap in research, and findings will provide insight into the significance of intergenerational household living in the role of acculturation for Filipino American young adults and how it informs their experiences with mental health support. It contributes to the understanding of behavioral and cultural mindsets of mental well-being in hopes of refining preventative care and challenging the stigmatization of mental health in Filipino communities.

### Strategic Competition and Scientific Norms: U.S. - China Rivalry in AI and Semiconductors

Tatum Mosley and Kacie Miura

The growing competition between the United States and China is transforming how countries cooperate in science and technology, especially in areas like artificial intelligence and semiconductors. Longstanding principles such as open academic exchange, international collaboration, and ethical responsibility are now being challenged by national security concerns and government led technology policies. In the United States, measures like the CHIPS and Science Act and AI export controls reflect this shift, while China's Made in China 2025 plan and national AI strategy show a similar push toward technological self reliance.

This study uses qualitative methods, including document analysis and historical comparisons to Cold War era science diplomacy, to explore whether today's trends mark a major break from past models of scientific cooperation or represent continuity in a new form. By connecting technology policy to broader geopolitical and theoretical perspectives in international relations, this research sheds light on how global governance and scientific collaboration are evolving in an age of great power rivalry.

### Where the Pipes Meet the River

JB Barrientos and Megan Groth

Tijuana's rapid urban growth and industrial development have placed pressure on its water infrastructure, leading to ongoing pollution in the Tijuana River Watershed and beyond. In many areas, urban expansion has outpaced the construction of sewage and stormwater systems, leaving neighborhoods at risk. Industrial growth has often relied on outdated infrastructure or occurred without adequate systems in place. This research maps sewage lines, stormwater systems, water networks, pollution sites, and urban development patterns across the city to examine links between water contamination and infrastructure. Using ArcGIS, spatial data on sewer lines, stormwater networks, water pipes, electrical transmission lines, waterways, vegetation, airports, industrial zones, and wastewater treatment plants were analyzed alongside pollution incidents from the past five years. The results show that areas near maquiladoras and low-lying zones such as riverbeds and canyons have higher levels of contamination. Pollutants include fecal coliform, E. coli, and industrial chemicals like mercury and lead. These patterns suggest possible links between contamination and aging or inadequate infrastructure, though further research is needed to confirm these relationships.

### Between Shelter and Ash:A Process-Based Study on Fire-Resilient Recommendations for Wildland-Urban Interface Zones

Sandra Santos and Daniel Lopez-Perez

With the intensifying threat of wildfires across California, evident in the destruction of over 16,000 structures during the 2025 Los Angeles fires, there is an urgent need to reconsider how residential structures are conceived in fire-prone zones. While existing building codes and guidelines have made notable progress in addressing wildfire risk, their predominant focus on "home hardening" often overlooks the potential of site planning, spatial configuration, and architectural design as agents of wildfire resilience. Through this research, conducted through the McNair Scholars Program under the mentorship of Professor Daniel Lopez-Perez, my team and I developed a Wildfire-Resilient Design Guide and three connective drawings through a process-based, multi-scalar analysis of current wildfire resilience recommendations. This study takes a look at local, state, federal, international, and non-profit recommendations and reimagines the approach that the architecture field approaches fire-resiliency.

### Between Shelter & Ash

Daisy Morales-Zaragoza and Daniel Lopez-Perez

A fire-resilient home is not merely a structure hardened against ignition, but part of a multiscalar system of resilience operating across the building, site, and community. At the building scale, resilience emerges through noncombustible materials, compact geometries & ember-resistant detailing. At the site scale, defensible space, strategic landscape buffers & fire-adapted topographies extend protection beyond the home's footprint. At the community scale, coordinated infrastructure, zoning policies, and collective risk-assessment strategies shift wildfire resilience from an individual burden to a shared urban & ecological framework. By synthesizing these interconnected scales, architecture reframes wildfire resilience as an integrated design approach that bridges home, land, & neighbourhood into a cohesive system.

### DNA Ligation Slows Transport of Semidilute DNA Solutions via Active Entanglement

Dimitra Protopapas and Rae Robertson-Anderson

DNA ligase catalyzes the formation of phosphodiester bonds to anneal the ends of linear DNA strands, allowing DNA fragments to form long connected chains. In cells, ligation plays an essential role in replication, repair, and the formation of entangled structures. Here, we leverage in situ DNA ligation to introduce entanglements into semidilute DNA solutions with programmable time-dependence and degree of entanglement. Using fluorescence microscopy and differential dynamic microscopy, we analyze the dynamics of concentrated solutions of linear DNA strands of varying lengths as they undergo ligation. We demonstrate that DNA dynamics universally slow down as ligation continues over the course of minutes to hours. We observe sigmoidal dependence of diffusion on ligation activity time that indicates cooperativity between neighboring entangling chains. Surprisingly, we find that shorter DNA strands lead to faster and more pronounced slowing than longer strands. Future work will explore the role of DNA topology and concentration on the active mechanics, and introduce complementary enzymes that may cooperate or compete with ligation, providing a roadmap for designing dynamic, self-altering bio-based materials.

## Histologically Measuring Neuroinflammation in a Rodent Model of mTBI

Emma Mozalova and Jena Hales

Mild traumatic brain injuries (mTBIs) are neurological injuries that can lead to cognitive and behavioral impairments. Neuroinflammation, an important biological response to mTBIs, is largely mediated by microglia. The goal of our research is to examine neuroinflammatory responses following mTBIs using histological analysis of rat brain tissue. Over the past seven months, I have learned histological brain tissue processing techniques. This work began with sectioning preserved rat brain tissue using a sliding microtome to produce thin slices suitable for microscopic analysis. I then stained the tissue using immunohistochemistry to visualize and distinguish microglial cells within the brain tissue regions of interest and mounted tissue sections onto microscope slides. Using microscopy, I characterized microglia morphologies and quantified the amount of hypertrophic microglia to assess changes associated with chronic neuroinflammation caused by mTBIs. This summer, we will be testing rats on behavioral tasks following mTBIs, and their brain tissue will be analyzed to measure neuroinflammatory responses. By combining behavioral testing with histological analysis, our research aims to better understand how neuroinflammation contributes to cognitive outcomes following mTBIs.

## The Effects of Baculovirus on Different Species of Larvae

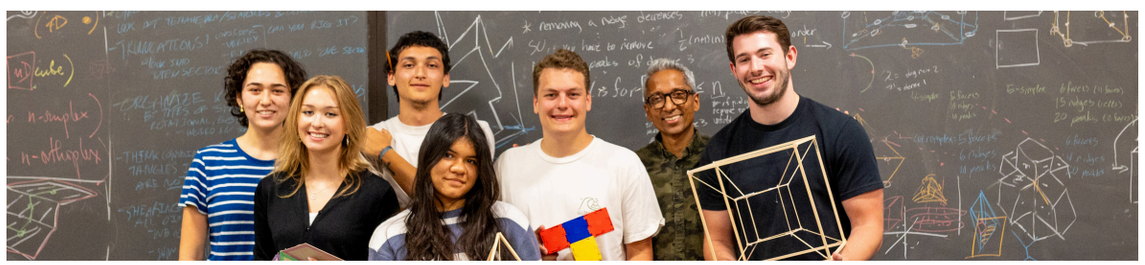
Yadira Dominguez and Arietta Fleming-Davies

Baculovirus is a pathogen that commonly infects butterfly larvae through consumption. Baculovirus uses proteases and chitinases to digest the protein and chitin within the host. Therefore, causing the larva to liquify. Specifically under Dr. Fleming-Davies' lab studies the different effects the virus has on Argualis vanillae commonly known as Gulf fritillary. Through this investigation more information on the butterfly species that are subject to Baculovirus infection can be revealed. In my study I focus on collecting data on how different larvae species are affected by baculovirus. NPV is a specific type of Baculovirus that infects certain butterfly species. The NPV we study in the lab is known to infect two butterfly species, and last year it was discovered to also infect a third species. Larvae species are collected among different states, the virus infected butterflies will be isolated, and it's genome will be sequenced. This is done in order to see of the virus strains that infect different species are genetically different.

## Team resilience in the NBA: When teams fall behind

Chloe Howel and Nadav Goldschmied

National Basketball Association (NBA) games have become more volatile in scoring as the pace of the game has quickened and reliance on the three-point shot has increased. This research analyzes 20-point scoring deficits and the comeback abilities of NBA teams from an archival and team resilience perspective, which is the ability of a team to deal with adversity. The collective experience of challenge by all team members is a process more complex to study than individual resilience due to the diverse interactions between teammates. Another aspect is the context of locale or home versus away in investigating these great deficit games. A series of Pearson correlations shows a greater frequency of such games in more recent seasons. It was also found that of games that hit a 20-point score difference and then return to a tie, both teams have roughly an equal chance of winning the game. This suggests that teams that fall behind by 20 points, as well as teams that lose this lead, demonstrate team resilience. Lastly, away teams are more likely to fall behind, but home teams are more likely to make a comeback. Ways to improve team resilience in professional basketball are discussed.



## Masculinity, Race-Evasive Ideologies, and Critical Consciousness among Undergraduate Men

Luke Blatney and Steven Berkley

The implementation of traditional masculine norms in socialization practices for young men can drastically change the way they understand themselves. Western culture places a strong emphasis on dominance, emotional restriction, and toughness, influencing how these young men react and adapt to their environments. College arrival appears to be a formative time that fosters some of the most change in thinking for young men, which can quickly become maladaptive when their primary form of nurturing was via traditional masculine norms. These norms regularly influence how these undergraduate men engage with discussions of race and inequality, often choosing avoidance over critical reflection. This study aims to identify the relationships between traditional masculine ideologies, race-evasive beliefs, and critical consciousness in undergraduate men. In doing so it provides a more nuanced understanding of these relationships, naming masculinity norms as a premier cultural barrier to the development of undergraduate men. This further highlights the importance of gender socialization, as it can be a key preventive measure for the development of race-evasive ideologies in undergraduate men.

# SESSION 2 (1:15 PM - 2:15 PM)

## A Crisis of Authority: President Eisenhower and Dien Bien Phu

Camille Van Bruaene and Kathryn Statler

The Vietnam War profoundly reshaped the American public's trust, military strategy, and the domestic political landscape. This research examines a pivotal moment in American foreign policy: President Dwight D. Eisenhower's inability to secure congressional authorization for intervention at Dien Bien Phu in 1954. Drawing on a comparative historical analysis of congressional records, declassified executive documents, and secondary policy literature, I argue that this non-intervention resulted from congressional anti-unilateralism following the Korean War. Still scarred by the high casualties and unilateral burdens of the Korean conflict, Congress successfully asserted its constitutional role by demanding a multilateral coalition as a prerequisite for intervention. By successfully asserting conditional authority during the 1954 Dien Bien Phu crisis, Congress challenged the "imperial presidency" narrative and established a model for legislative oversight that restrains unilateral executive action. This historical precedent created a lasting mandate that continues to serve as a vital safeguard in modern constitutional debates regarding the scope of presidential war-making authority.

## "My Voice is My Sword": Speech and Silence as Methods to Control Tragic Women

Madison Harkin and Maura Giles-Watson

In this piece, I examine the control of tragic women through harmful communicative strategies. The plays discussed were written by Aeschylus, Euripides, and William Shakespeare. The women characters often face gendered discrimination by way of others' words and forced silence, effectively reducing agency. The long-appreciated plays I question here must be critiqued rather than simply admired. I argue the plays do not exist without a historical, social, and political context that encourage unjust treatment of women, particularly women of color. As a result, I discuss these plays by taking on a feminist lens and addressing intersectionality and critical race theory. Further, the characters were created with the intention of appearing on stage so they may be understood under the guise of communication. Some relevant communication frameworks include: muted-group theory, where social structures like the patriarchy impact communication dynamics; genderlect theory, wherein gender dictates communication; and, dramatism, which views human interaction as if they are on stage. These theories both address the plays as they are – as dramas – and in the context of real social constructs. The discussion aims to recognize why communication becomes one with power on stage and why real social structures appear in drama.

## In God's Image: Re-reading Scripture Through Disabled Embodiment

Jack DeVries and Rev. Lark Stephenson Diaz

Christian theology has long wrestled with the meaning of disability, often interpreting bodily difference through categories of defect, punishment, or tragedy. These interpretations shaped doctrine, church practice, and thus the lived experiences of disabled Christians. However, biblical canon offers a more expansive vision in which individuals with disabilities appear as participants in God's creative and redemptive work rather than theological problems to be explained. Beginning with biblical and lexical analysis, this project argues that Scripture presents disability within God's creative intention, covenantal community, and vision of the Kingdom of God. It then traces how later theological traditions increasingly linked the image of God to rationality, independence, and bodily "wholeness," contributing to exclusionary assumptions. Contemporary disability theology challenges these inherited frameworks by rereading core doctrines through the lens of vulnerability, interdependence, and the wounded yet resurrected Christ. These perspectives suggest that disability is not marginal to theology but central to understanding human embodiment, community, and divine grace. Reconsidering disability within the Christian tradition reveals human diversity as essential to the image of God and to the Church's vocation of inclusive belonging.

## Pattern Interrupt:  AI's Challenge to the Economic Categories of Labor, Capital, and Technology,  and the Future of Work in an Age of Intelligent Machines

Eleanor Soininen and Kobi Finestone

This paper examines whether artificial intelligence necessitates a fundamental reconceptualization of the classical economic categories of labor, capital, and technology. Drawing on Adam Smith, Karl Marx  and contemporary empirical research by Acemoglu and Restrepo, Webb, and others, it develops a three-tiered analysis of AI's categorical implications. Narrow AI, defined as software-based algorithmic systems, fits comfortably within existing frameworks as a non-rivalrous form of technology. Embodied AI, defined as physical robots equipped with adaptive cognitive capabilities, creates genuine categorical tension by combining capital's physical properties with labor's cognitive functions. Artificial general intelligence, as a hypothetical limit case, would potentially collapse categorical distinctions entirely. The paper argues that embodied AI is best understood as capital, but capital of an historically unprecedented kind whose arrival radically redefines which human contributions retain economic value. Synthesizing Lorraine Daston's distinction between thin and thick rules, the paper concludes that the human labor least vulnerable to automation is not credential-bearing procedural expertise but contextual judgment, creative synthesis, and domain-specific knowledge. The paper closes with implications for education reform and economic policy.

## Shakespeare and the Performance of Religion: The Echoes of Religious Hybridity in Virtue and Vice

Carly Senteno and Maura Giles-Watson

In Shakespeare's work, he presents the opposing forces of virtue and vice through his representations of forgiveness and mercy, as well as revenge and violence. Due to the cultural and religious contexts of Shakespeare's newly Protestant England that continued to struggle with its former—and, by 1564, illegal—Catholic identity, there lies ambiguity in the moral meaning of his plays. Understanding religious hybridity is to recognize the politics that propelled the art of theatre forward in Shakespeare's time of censorship and scrutiny. This project explores the way in which Shakespeare's plays resonated with Catholic and Protestant audiences, and how they actively critiqued the faults within religious morality through their ambiguity. His work not only critiques religion, but uncovers the changing image of what it means to be a "good" English person in the manner of politics and national identity. This project is devoted to understanding the layers of theology and history that craft the meaning underpinning Shakespearean literature that continues to be revered for its moral and ethical critiques.

## Medieval Metadata

Gianna Eaton and TJ Tallie

This research examines the historical continuity between medieval cartography and contemporary artificial intelligence as technologies of control, propaganda, and power. Maps function not merely as factual geographical representations, also serving as visual displays of communication, status, and power that construct monolithic narratives about outsiders while reinforcing existing hierarchies. By analyzing medieval maps as visual propaganda in colonial contexts, this study establishes a framework to interrogate how AI-generated imagery similarly distorts information and harms the marginalized through propaganda and objectification.Central to this investigation is how AI, like historical cartography, serves to redefine or reify world order through visual representation of difference. Through interconnected case studies spanning different technological paradigms, this research reveals persistent patterns in how societies map, visualize, and ultimately rely on difference to reinforce hierarchy. The findings contribute to emerging interdisciplinary conversations about ethical technology development by situating contemporary AI ethics concerns within a broader historical context of visual technologies and their role in constructing the Other.

## Shared Kitchens Changing the Housing Development

Agniya Seliuzhytskaya and Marcel Sanchez Prieto

In response to the housing crisis and ongoing economic disruptions, many individuals have turned to home-based food entrepreneurship for financial stability. The Microenterprise Home Kitchen Operation (MEHKO) program allows residents to legally run small-scale food businesses from their kitchens, blurring the line between domestic and commercial space. This research examines how MEHKOs challenge conventional ideas of housing, domesticity, and zoning, and explores how adaptable kitchen models might inform new housing types.
The study combines spatial and policy analysis by mapping approved MEHKO sites in San Diego and comparing them with U.S. Census population and density data to understand the communities served. It also reviews zoning regulations that permit commercial activity in residential areas, highlighting regulatory tensions and limitations. Findings show that MEHKOs operate legally within residential zones while complying with housing codes, creating a hybrid model that challenges traditional urban classifications. This raises broader questions about how architecture and policy can evolve to support flexible live-work arrangements. The research also considers implications for housing design, including accessory dwelling units (ADUs), lot-splitting policies, and new zoning categories that formalize these hybrid domestic economies.

## Should school board elections be partisan? Analyzing elite Should school board elections be partisan? Analyzing elite discourse in the debate over the structure of local elections discourse in the debate over the structure of local elections

Bre'Arra Long and Evan Crawford

This research paper's goal is to identify the prevalent arguments for and against partisan school board elections while also examining what differences, exist between Republicans and Democrats with respect to how the issue is discussed. The interdisciplinary fields of political science and linguistics provide helpful context to the effectiveness of political communication in smaller scale, yet salient elections in communities where impacts are most directly felt. My interest lies in how the nationalization of politics influences local elections and how language and the media act as conduits for that relationship. It is important to undertake this research due to the implications that could arise if there is a significant difference in Republican or Democratic support for or against the addition of adding party labels to school board ballots. To identify both the arguments I code descriptive data found in local newspaper articles from Arizona, Florida, Indiana, and Kentucky. These four states represent various outcomes regarding the proposal of shifting to partisan elections for school board officials. The goal of this research is to provide nuance when it comes to the linguistic tactics employed that effectively shape the political sphere and collective sentiment about local issues that are increasingly becoming nationalized.

## Lessons About Girlhood: Case Study of a Social Media Kidfluencer Collective

Cherishann Diamzon, Kaitlin Trauscht, and Susannah Stern

Tween girls spend significant time on social media, and early adolescence is a key period for identity formation and social comparison. What lessons do social media platforms featuring girl influences offer as girls figure out who they are and how to fit in? This study examines Glow House, a managed account of teen girl influencers. We analyzed 80+ videos across TikTok, Instagram, and YouTube to identify the hidden curriculum embedded in its content. Our findings show a consistent emphasis on togetherness over individuality. The girls present a unified front, rarely expressing personal opinions, and display a narrow, consistently upbeat emotional range, even in situations that might warrant more complexity. Membership is portrayed as highly desirable, yet the criteria for inclusion remain opaque. Overall, the account promotes a performative model of friendship and belonging, where acceptance appears tied to appearance, positivity, and group conformity. It frames beauty, social status, and consumerism as central to successful girlhood, despite research suggesting other values better support girls' well-being.

## Hunting for a Suppressor of Toxicity in a Fly Model of Alzheimer's Disease

Alaya Chapa and Adam Haberman

Alzheimer's disease is a degenerative disorder affecting the neurons within the brain. The disease progresses as a protein called amyloid-beta congregates outside of the neurons. Neuron death is caused by the action of amyloid-beta aggregates inside and outside the neurons. We examine the effects of amyloid in the eyes of the fruit fly Drosophila melanogaster. This organism is an effective model because it shares key biological pathways with humans including those involved in neurodegeneration. In our experiment, amyloid-beta has caused severe degeneration in some flies and mild degeneration in others. The group that experienced less degradation indicates the presence of a suppressor mutation that reduces the toxicity of the amyloid. To identify the suppressor mutation, we are first breeding the flies to isolate flies who all carry the unknown mutation. We seek to make stocks that are homozygous for the suppressor (all flies have less degradation) and for the wild type allele. This will provide a platform for genomic comparison which permits the identification of the specific suppressor mutation.

## The Formation of Bisphosphine Ligands with the Support of Boron Reagents

Daivion Terry and Timothy Clark

Pharmaceutical compounds have a tendency to be chiral, meaning they represent one of two mirror images. Even though two mirror-Image molecules share the same properties they do not behave identically in every situation. Often the other mirror image of a molecule may have negative health impacts. To increase the likelihood of a specific chiral state, metals are used in the synthesis of pharmaceuticals as a selective pressure toward a specific chiral configuration. My project focuses on the development of new tools to synthesize important ligands, molecules that aid metals as selective catalysts. Through the use of carbon-boron bonds we're able to develop phosphoric ligands that can aid metal catalysts as selectors for chiral states.

## Synthesis of Aldehydes From Ketones via gem-Diboronates

Franki Flores, Timothy Clark, and Arturo León Sandoval

Organic chemistry focuses on the study of carbon-containing compounds. A key application of organic chemistry is in pharmaceuticals and cosmetics. This research focuses on homologating a ketone, the process of adding a carbon to a molecule through a series of reactions. We are working with the homologation of ketones to aldehydes via gem-Diboronates. The ketone is our starting point for the homologation. The gem-Diboronate is an intermediate molecule, containing boron groups, which serves as the middleman. The product, an aldehyde, contains an additional carbon in comparison to the ketone structure. The difference of one carbon is distinct in structure, function, and value compared to the starting ketone. Our research can be applied to produce building blocks for pharmaceutical applications.

## Role of Microglia in Neuroimmune Responses and Neuroinflammation

Samantha Luna and Jena Hales

Microglia are the primary immune cells of the central nervous system and play a central role in neuroimmune responses and neuroinflammation. In their resting state, they monitor the brain environment; however, in response to injury or illness, they become activated. They migrate to affected areas, change morphology, and release inflammatory signals. Our research aims to investigate neuroinflammatory responses after mild traumatic brain injuries (mTBIs) by analyzing rat brain tissue using histological methods. Animal models of mTBIs provide us a controlled way to study microglial activation patterns and progression of inflammation. Over the past seven months, I have gained experiences in mounting brain tissue sections, imaging stained tissue, and quantifying microglia. This summer, I plan to expand this work by conducting behavioral and cognitive testing in rats following mTBIs, while continuing to measure neuroinflammatory response to better understand the relationship between brain changes and behavior.

# THURSDAY, APRIL 30, 2026

## SESSION 1 (12:15 PM - 1:15 PM)

### Integrating Indigenous Use of Materials into Engineering Education
Vivien Papp and Susan Lord

Indigenous Traditional Knowledge (ITK) is rarely integrated into technical engineering curricula, despite offering valuable alternatives to dominant Western material paradigms. To address this gap, I designed and implemented a sociotechnical module for a required materials science course at the University of San Diego. The module centers on materials of cultural and functional significance in Indigenous communities such as turquoise, bison sinew, and red cedar for totem poles. It guides students to connect material identity, technical function, and geographic context through a regional lens from various North American tribes and nations. Indigenous approaches to material selection foreground adaptability and sustainability, offering valuable frameworks for engineering education. I investigated how the module influenced student perceptions of value in engineering. This work offers a practical model for implementing culturally responsive, sociotechnical instruction that enhances student capacity to navigate complex, interdisciplinary engineering challenges. As an engineering student from an Indigenous heritage, I believe in the value of integrating an interdisciplinary approach to engineering education through Indigenous knowledge systems and wisdoms.

### Modeling unfolding cubes and cuboids in n-dimensions
Caroline Nasiak, Eva Kaskak, and Satyan Devadoss

The study of polytope unfoldings explores how higher-dimensional geometric objects can be represented in lower dimensions by cutting along their ridges; in three dimensions, the cube–composed of six square facets–admits exactly eleven distinct edge-unfoldings into the plane, all of which are non-overlapping nets. This phenomenon extends naturally to higher-dimensional cubes, where an n-dimensional cube unfolds into its (n-1)-dimensional facets. Building on prior work by Dr. Satyan Devadoss, this research investigates ridge unfoldings of higher-dimensional cubes encoded with Robert graphs, which model adjacency relationships between facets as a systematic way to track unfolding structures. We extend this model to cuboids, defined as n-dimensional assemblies of unit cubes such that only exterior facets are considered. Unlike normal higher-dimensional cubes, cuboids introduced additional complexity due to the presence of sub-facets grouped with larger “mega-facets.” To address this, we introduce “Mega-Bert graphs,” a modification of Robert graphs that captures interactions between sub-facets.

### Motor and feeding behavior of a sea anemone following gut-microbiome depletion
Bridget McFall and Cawa Tran

As coral reefs continue to face a challenging climate, the microorganisms within the ecosystem and within corals themselves will continue to shift. In complex organisms like humans, the gut microbiome has been linked to brain functioning, but this bidirectional gut-brain axis is not fully understood. Meanwhile, cnidarians like corals and the sea anemone Exaiptasia diaphana (Aiptasia) possess primitive nerve nets and gut microbiomes. Aiptasia consists of a complex core microbiome containing hundreds of microbial partners that contribute to various aspects of host fitness, such as its biomass and asexual reproduction. Thus, the gut-“brain” axis of Aiptasia provides a unique opportunity to investigate how disruption of the gut microbiome may alter neural activity and observable motor behaviors. In this study, the Aiptasia microbiome was depleted via direct administration of a broad-spectrum antibiotic concoction (carbenicillin, chloramphenicol, nalidixic acid, and rifampicin) and changes in motor behavior were subsequently observed and quantified. Tilt behavior was significantly reduced in antibiotic-treated Aiptasia. Antibiotic-treated anemones were also less likely to feed on brine-shrimp larvae as there was a remarkable change in the spread of tentacles to capture food.

### Microrheology of Actin Networks: MSD of PEGylated Beads Following Cofilin Introduction
Adrianna Galvan and Rae Robertson-Anderson

Actin is a key component of the cytoskeleton that influences the mechanical behavior of cells by forming dynamic networks that provide structural support and enable processes such as cell movement, shape changes, and intracellular transport. These networks are constantly remodeling by actin growing into filaments (polymerization) and falling apart (depolymerization), allowing them to reorganize and respond to different conditions inside and outside of the cell. In this experiment, we embedded microspheres in actin networks and used fluorescence microscopy to measure their motion to determine how filament polymerization and depolymerization affects the mechanical properties of the network. We prepared samples under polymerizing conditions in the presence and absence of the actin-binding protein cofilin, which enhances filament depolymerization. We tracked and analyzed the motion of microspheres and quantified their mean squared displacement (MSD). We found that microspheres in networks containing cofilin are showing higher MSD values, while networks without cofilin restrict particle motion because they form more stable filaments.

### Synthesis of Aldehydes From Ketones via gem- Diboronates
Judith Garcia Leon, Timothy Clark, and Arturo León Sandoval

Organic chemistry plays a crucial part in life because of carbon’s complex structure. In this research project, we are focusing on homologation, the ability of adding an additional carbon unit to a molecule through various reactions. We are forming aldehydes from the substrate, ketone via gem- diboronates. Our research allows us to synthesize building blocks for the pharmaceutical industry just by adding the additional carbon.

## Using Particle Tracking to Measure Viscosities of Biomaterials

Geraldin Ramirez Velazquez and Rae Robertson-Anderson

This project seeks to measure the material properties of complex viscoelastic biomaterials such as biofilms. This is important for understanding how phages, drug delivery particles, and other therapeutic agents move through these systems. Because biofilms are tiny, fragile and structurally complex it makes it difficult to use well known methods such as rheology to measure their material properties. Therefore, we use particle tracking as an alternative approach for characterizing material properties such as viscosity by analyzing the motion of embedded microspheres. To demonstrate how particle tracking can determine material properties, we investigated the motion of beads diffusing in glycerol solution of different viscosities. Particle motion was quantified using mean squared displacement (MSD), which measures how far the particles move over time. The results showed clear differences in particle motion for the different glycerol concentrations from which we can determine viscosity. Our measured viscosities match expectations, showing that particle tracking is an effective non-invasive approach for measuring material properties. The next step towards this project will be to extend this method of study the material properties of different types of biofilms subject to different therapeutic treatments.

## Creatures of habit - decision making under pressure in the NBA

Claire Sheerin, Yaron Guberman, Sophia Stark, and Nadav Goldschmied

This study examines decision-making under pressure in NBA games during the final five seconds when the shooting team is either tied or trailing by one point. Over the past decades, the frequency of three-point attempts in the NBA has increased substantially,which can influence players to opt for a three-point shot even in situations where a less risky closer range two-point shot would still win the game. Using a Generalized Estimating Equations (GEE) analysis, we examined shot attempts across 26 NBA seasons (2000/1–2024/5), covering 4,078 plays. The results show that over time there has been an increase in attempting three-point shots in situations where a two-point shot would be sufficient to win the game. This finding suggests that even highly trained NBA players may rely on habitual patterns rather than purely rational decision-making in high-pressure situations. Interestingly, when a timeout is taken before the possession, the likelihood of attempting a three-point shot decreases significantly, suggesting that a brief pause for deliberation may help players override habitual decision-making.Furthermore, we find that the three-point strategy is counterproductive with a win rate of 47.7% vs. 54.7% for the two-point option.

## Declining Home-Field Advantage? An Analysis Across Major North American Professional Sports Leagues

Arianna Hahn and Nadav Goldschmied

Home-field advantage (HFA)—the phenomenon that highlights the benefit a team gains from playing on its home field—is widely recognized in professional sports, though its magnitude varies over time and across leagues. The present study examined whether HFA has changed since the start of the 21st century in five major North American professional leagues: Major League Baseball (MLB), National Football League (NFL), National Hockey League (NHL), National Basketball Association (NBA), and Women's National Basketball Association (WNBA). Archival season-level data were used to calculate HFA as the ratio of home wins to total home games for each season. Kendall's tau-b correlations indicated a decline in HFA for the NFL, NBA, and WNBA. In the NFL, a medium effect size (-.3 to -.5) corresponded with a decrease in HFA from 55.6% in 2000 to 53.3% in 2024. The WNBA also showed a medium effect, with HFA dropping from 59.8% to 52.5%. The NBA demonstrated a large effect (above -.5), with HFA decreasing from 59.8% to 54.4%. It is postulated that, in basketball, the increasing reliance on the three-point shot may reduce referees' influence and bias, which have historically been cited as key factors in home-field advantage.

## Measuring What Matters

Briana Burton, André Hutchinson and Ky Snyder

In alignment with USD's Lighting the Way to 2030 strategic plan, I am serving as the sole student representative on the Steering Committee for the Campus Space Study. This initiative utilizes over 1,500 Occuspace sensors to capture real-time occupancy data with 95% + accuracy, aiming to optimize resource allocation and reduce our environmental footprint. Through my McNair research, I'm collaborating with the architectural firm SmithGroup to translate this data into actionable policy. By benchmarking USD against peer institutions, like UC San Diego, I am helping develop a spatial data dashboard and a final report due in May 2026. Ultimately, this work ensures that university growth is sustainable, inclusive, and centered on student well-being.

## Radiation from Black Hole Accretion - Relativistic Spectra

Christian Rincon, Anthony Romo, and Theodore Dezen

This study examines stellar black holes and their accretion disks to better understand the radiation we observe from them. We present numerical models of radiation from these systems and focus on how relativistic effects that determine what an accretion disk would look like to far away observers such a space telescope near Earth.

## Examining the effects of mild traumatic brain injury on cognitive measures and neuroinflammation in female and male rats

Vera Maaskant and Jena Hales

Throughout our current healthcare system, there is evidence of sex- and gender-bias that has a basis in long-standing inequities that have shaped research priorities. Historically, both clinical and preclinical studies have disproportionately focused on male subjects, contributing to gaps in understanding female health and disease. Although policy efforts have aimed to address these imbalances, meaningful implementation remains inconsistent. To address these biases, we have incorporated sex as a biological variable to examine the cognitive and neuroinflammatory responses of mild traumatic brain injuries (mTBI). Female and male rats were evaluated for memory, anxiety levels, locomotor deficits, and spatial navigational approaches. Simultaneously, neuroinflammatory responses were assessed in key brain regions associated with these cognitive functions, including the medial prefrontal cortex, hippocampus, and medial entorhinal cortex. Microglia, the resident immune cells of the central nervous system, undergo morphological changes in response to injury, providing insight into inflammatory responses. This study aims to identify sex-dependent differences in mTBI outcomes and contribute to a more comprehensive understanding of brain injury pathology, and support the development of more inclusive and effective treatments.

## Identification of Potential Apatite Binding Surfaces of Salivary Cystatins

Josiah Lee, Nick Narloch, Samarah Azzi, Jessica Bell, and Ellis Bell

Salivary cystatins (S, SA, SN) protect tooth enamel and inhibit proteases from oral pathogens, yet the molecular details of their hydroxyapatite interactions remain unclear. This study characterizes these interactions through computational docking and biochemical analysis. Using Phyre2-generated models and AutoDock Vina, we identified five high-affinity calcium-binding sites conserved across all three cystatins (notably residues Y64/R65, Y83/F85, E42/R46, F85/R72, C94/C104). Interestingly, Site 3's proximity to W127 suggests enhanced Coulombic interactions between calcium and the two amino acids. We also localized five potential phosphate-binding sites (including F84/E128/N135, F84, E88/R74, K57/Y64/D102, and C138/136). Together, these sites form a potential apatite-binding surface that could impact protease inhibitory activity. To validate these findings, human cystatin SA was expressed from pET26b into the bacterial periplasm and purified via IMAC. Calcium-induced conformational changes were monitored via tryptophan and terbium fluorescence spectroscopy. Furthermore, cystatin SA inhibition of papain +/- calcium was assessed to characterize the impact of a Ca2+:cystatin:papain ternary complex on thiol protease inhibition. Ultimately, these studies help clarify how salivary cystatins maintain dental integrity within the oral microbiome.


## SESSION 2 (1:15 PM - 2:15 PM)

## Reusable Cup Initiative (ESW)

Brynn Gerty, Alyssa Robertson, Caroline Mahoney, Graviella Graves, Colette Patterson, Susan Lord, and John Alejandro

Engineers for a Sustainable World (ESW) at USD is working to eliminate single-use cups on campus. Plastic cups can take 200–450 years to decompose and break into harmful microplastics. Paper cups are plastic-lined and not recyclable, and only a small portion of recycled cup waste is processed. Based on data collected by ESW, 7,495 single-use cups were used at La Paloma, a USD cafe, in March 2026—this represents only a portion of cups used at USD. A 2025 student Life Cycle Analysis concluded that reusable mugs outperform single-use cups in every category including long-term cost, water usage, greenhouse gas emissions, and solid waste. We believe that to bring USD's vision of sustainability to life, single-use cup usage should be eliminated. Other schools have already banned single-use cups, incentivizing students to bring their own and use on-campus washing stations. Our team surveyed over 250 students and found that while 84.2% own a reusable mug, 87.4% still use single-use. However, only 4.7% oppose eliminating single-use cups. Our data makes a strong case for reusable cups at USD and we hope to work with leadership and dining services to implement solutions for a smooth transition.

## A Toolset for Analyzing Multimodal Data

Michael Rosalia, Jennifer Olsen, and Sophia Krause-Levy

The use of multimodal data to understand and support collaborative learning has grown in popularity recently as it allows researchers to study complex learning tasks from different facets. However, multimodal analysis is often computationally complex and often requires a strong set of technical skills and mathematical understanding to clean and process the data, creating barriers that restrict researchers without advanced programming skills from conducting these analyses. There are existing software packages that can help with this process, but they are often piecemeal requiring the user to understand how to put them together and what best practices may entail. This can create a barrier of entry for most researchers. Our toolkit addresses this challenge by providing researchers with an accessible, well-documented toolkit for synchronizing and analyzing multiple data streams from collaborative learning environments.

## Impact of AI on Collaborative Learning Processes During Coding Activities

Sara Teferi and Jennifer Olsen

AI is a growing concern with how it is impacting learning within education, and understanding how to utilize it within classrooms is the ticket to a flourishing education. Research has shown that students who work together in pairs using AI have a stronger understanding of the material versus pairs that don't use AI, which can lead to higher assignment scores, stronger conceptual understanding, and more effective collaboration with students. However, currently there has been no research looking into how AI is integrated into the learning process, which is why our research will provide new insights directly from students. To investigate the impact of AI on the learning process, we are gathering audio and log data of pair interactions for 12 weeks across 4 CS labs, and we will then analyze these data during summer to explore the patterns in how our students have been utilizing AI and the type of conversation that ensues while using it. These results will provide guidance to instructors in how to develop collaborative activities that integrate AI.

## Inhibition of Aminoacyl-tRNA Synthetases by Truncated tRNAs

Jonathan Martin and Anthony Bell

Aminoacyl-tRNA synthetases (aaRSs) are essential for maintaining translational fidelity by charging tRNAs with their cognate amino acids. Alanyl-tRNA synthetase (AlaRS) specifically charges tRNA-Ala with alanine. This project establishes a controlled system to examine how perturbations in AlaRS-dependent aminoacylation influence protein translation and cellular viability. Despite their specificity, some aaRSs, including AlaRS, can recognize shorter substrates such as tRNA minihelices. tRNA minihelices are truncated tRNAs that retain key identity elements for synthetase recognition but lack structural features required for ribosomal translation. Because of this, they can act as decoys that engage AlaRS and divert activity away from full-length tRNA-Ala, to disrupt normal translation elongation. To establish control conditions to challenge AlaRS expression with tRNA minihelices. Preliminary observations show fewer AlaRS colonies based on growth/expansion time, used to challenge tRNA-Ala minihelices. We expect a minimal number of clones to be generated in the presence of minihelices.  Resulting clones will be expressed, purified to determine the presence of full-length or truncated proteins. This system provides a platform to study how disrupting tRNA charging impacts translation and may inform strategies for targeting aminoacyl-tRNA synthetases.

## Designing Fire -Proof Neighborhoods

Arlene Garcia Guzman and Daniel Lopez-Perez

Acknowledging the complexities of ignition prone mechanisms in building construction necessitates a focused understanding of protective strategies. Defined as wind blowing objects, burning debris, that are most prevailing in occasions of high heat humidity, embers are the principal cause of structural loss in Wild-Urban Interferences. This proposal details a critical evaluation of fire behavior resistance through various material and architectural design elements, under ember exposure in efforts to inform a more effective preventative architectural strategy.

## The Crucial Role of Grassroots Social Organizations in Advancing Immigrant Legal Protections and Reshaping Immigration Policy

Isabella Reynolds and María Plascencia Galindo

Rooted in community experiences, this research project examines how grassroots social organizations contribute to advancing immigrant legal protections and shape immigration policy, focusing on formerly incarcerated migrants in California. I analyze case studies and the personal experiences of organizers from Homies Unidos, Border Angels, and other organizations that operate near the San Diego–Tijuana border region. The study illustrates how these groups provide essential services, mental health support, and community-based initiatives for vulnerable and formerly incarcerated immigrants. By conducting oral histories and ethnography as methods for preserving emotional labor and memory, this research challenges narratives that criminalize undocumented youth and marginalized populations, and sheds light on the structural inequities embedded in immigration enforcement. The project findings illustrate how community organizations serve as indispensable connectors between migrants and safety net resources, which advances humane immigration progress through interdisciplinary outreach, healing techniques, and reimagined systems.

## The Optimized Modular Synthesis of Lysine-derived Antimicrobial Polymers

Abigail McDowell and Joan Schellinger

Antibacterial resistance is an escalating global health crisis that threatens the effectiveness of conventional antibiotics, highlighting the need for alternative antimicrobial strategies. Antimicrobial peptides (AMPs) are attractive candidates because their amphiphilic structures enable them to interact with and disrupt negatively charged bacterial membranes, but their broader use is limited by difficult and expensive synthesis. This project investigates lysine-derived antimicrobial polymers designed to mimic AMP function while improving synthetic versatility, and sustainability. Specifically, three modular synthetic routes were explored, differing in the sequence of coupling, deprotection, and RAFT polymerization, allowing systematic variation of cationic and hydrophobic groups. Route three showed linear monomer conversion under conventional heating conditions, as determined by 1H NMR peak integration. The post-polymerization coupling strategy also enabled controlled lysine conjugation, which was monitored by IR spectroscopy through the appearance of the carbamate stretch at 1705 cm-1. Expanding this polymer library will support future studies of structure-property relationships in antimicrobial activity and advance sustainable approaches to antimicrobial materials.

## Optimization of a Green Solid-Phase Peptide Synthesis of Peptide-pi Conjugates

Rebecca Albracht and Joan Schellinger

Peptide-pi conjugates are versatile biologically relevant molecules, composed of an aromatic perylene core functionalized with two peptide chains on opposite ends. These molecules have potential in diverse fields, such as for optoelectronic and biomedical applications (Kim et al., 2018). Preliminary work has been carried out to synthesize this molecule, however this method uses toxic reagents such as pyridine, DMF, and DCM, extremely high temperatures, as well as reaction times extending beyond 24 hours (Ardoña & Tovar, 2015). The aim of this project is to optimize a greener synthesis of this molecule, by adapting the solid-phase peptide synthesis methodology to reduce the usage of hazardous reagents and waste. 2-MeTHF is a biologically derived solvent that has shown promise as a solvent in solid-phase peptide synthesis, providing a viable alternative to DMF and DCM. Ultrasonication has been used to increase the efficiency of peptide synthesis reactions by using sound-wave agitation to increase reaction kinetics (Motolla et al., 2025). Optimal conditions were found to synthesize different peptide chains, replacing DMF entirely with 2-MeTHF and cutting reaction times by half by using ultrasonication. Preliminary work has been carried out to synthesize the peptide-pi conjugate, while further optimization is needed to increase the yield.

## Aging Smoke: Hygroscopicity and Viscosity

Stella Osman and David De Haan

In this lab, we used the Hygroscopic Growth and Bounce (HGAB) instrument to study how smoke particles behave in the atmosphere. The HGAB measures hygroscopicity, which is how easily particles take up water from the air, and bounce fraction, which relates to particle viscosity, meaning whether particles act more like liquids or solids when they hit a surface. We looked at smoke that was aged under conditions, including dry and cloudy environments, as well as exposure to oxidants like OH radicals, ozone, and a control with no oxidants. These conditions let us see how aging changes the chemical and physical properties of the particles over time. As smoke ages, atmospheric reactions change its composition, which affects how much water it absorbs and its viscosity. This is important because smoke from wildfires and biomass burning contains brown carbon, which absorbs sunlight and contributes to warming. Changes in hygroscopicity affect how particles grow into cloud droplets, which impact cloud formation and weather. At the same time, changes in viscosity influence how sticky or solid-like particles are, affecting how they bounce or stick to surfaces. Overall, this lab shows how aging changes smoke behavior and impacts air quality, climate, and the environment.

## Water Extraction from Banana Stems Senior Design

Kate Flaherty, Rose Seaver, Turner Grubbs, and Marissa Forbes

Many rural regions of Uganda, access to safe drinking water remains a critical challenge, where communities often rely on traveling long distances to contaminated boreholes and wells to collect water, disproportionately impacting women and children, limiting education opportunities. Banana tree stems are an abundant agricultural byproduct in Uganda, containing significant amounts of extractable water that are typically discarded. The objective of our project is to develop a low-cost mechanical device using locally available resources to produce water locally, in partnership with the Mbarara University of Science and Technology (MUST). Two different, technically effective designs were brought to Uganda to observe compatibility with the environment, and select a final design based on user feedback. The final designs meet the user requirements defined by the MUST students that are feasible, low-cost, and adapted to their intended environment. The device extracts water from banana stems in a simply-mechanic manner, constructed with locally sourced materials and tools to reduce the risks associated with procuring water from contaminated sources in rural Uganda. The final engineering design successfully extracts water from a banana stem at an efficient rate to reduce time spent collecting water, and exposure to contaminated water and water-born diseases.

## Aquatread
Patrick Matthews and Daniel Codd

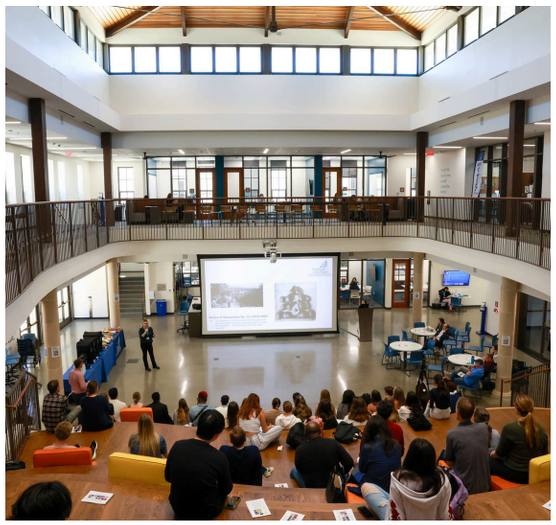
Aquatread reimagines how humans interact with water by transforming walking and running into a seamless, on-water experience. This innovative human-run system integrates a treadmill mechanism with a buoyant hull to enable users to move efficiently across water while maintaining stability and control. Designed to achieve correspondent running speeds, Aquatread emphasizes safety, durability, and mechanical performance through a slat-based treadmill system and a structurally optimized frame. Key components were evaluated using finite element analysis, including bolt bearing stress and factor of safety calculations to ensure reliability under repeated loading. To assess hydrodynamic performance, a scaled hull model was experimentally tested across varying speeds to calculate the Froude number and evaluate resistance, while also examining side-to-side oscillatory motion. Initial testing revealed instability caused by resonance effects, which informed iterative design improvements that enhanced overall stability and performance. Aquatread demonstrates the potential to merge mechanical and fluid systems into a novel form of water-based mobility, offering promising applications in recreation, fitness, and alternative transportation while highlighting the importance of experimental validation in engineering design.

## Torero Space Program
Jacob Ramirez and Daniel Codd

The Torero Space Program (TSP) represents the University of San Diego's entry into the growing field of small satellite development. TSP is designing and building a CubeSat — a miniaturized, standardized satellite format widely used by universities and industry — that will capture images of Earth from approximately 340 miles above the surface. This year, TSP laid the groundwork for what is anticipated to be a four-year, fully interdisciplinary engineering endeavor. The team surveyed industry standards, established a system architecture, and made meaningful hardware progress across several technical areas. Notably, the team designed, built, and tested the satellite's physical structure and its orientation control system — the mechanism that keeps the satellite correctly pointed in space using Earth's own magnetic field. A project of this scale requires coordinated development across five distinct subsystems, demanding collaboration, project management, and long-term planning. As a result, TSP placed equal emphasis on technical development and knowledge transfer, ensuring continuity as new students join the team each year. TSP reflects USD's commitment to hands-on, mission-driven learning — giving students real-world experience in one of today's most exciting and rapidly expanding industries.

## CO2 Emission Estimation With Machine Learning Methods
Makan Ahadian and Maryam Keshtzari

Estimation of power-plant–level $CO_2$ emissions is essential for monitoring greenhouse gas sources and supporting decarbonization efforts. Existing facilities overlook plant-specific structural and contextual differences, which motivated my, and Dr. Maryam Keshtzari's project to focus on how accurately emissions can be predicted from non-activity features alone. We developed a machine-learning framework that isolated structural drivers from contextual signals using a sequence of baseline and gradient-boosting models. After learning that earlier models provided no predictive value, we trained a Gradient Boosting Machine (GBM), a self-learning machine learning prediction method, that achieved stronger performance. In analyzing feature-importance and feature-group testing, it showed that plant capacity dominated the emissions signal, while other contextual features provided smaller but still measurable improvements to our predictive model. Lastly, when checking our error deviations from the deterministic baseline model, we proved that our method gave us a clear and interpretable method to estimate plant-level emissions as the remaining difference between our predicted and actual emissions were very small and consistent across all emission ranges.



University of San Diego®

**OFFICE OF UNDERGRADUATE RESEARCH**
Maher Hall, Room 252
5998 Alcalá Park
San Diego, CA 92110-2492
(619) 260-7840

Email: ugresearch@sandiego.edu
www.sandiego.edu/ugresearch

## WITH GRATITUDE

Many thanks to all our student presenters and faculty mentors across all disciplines for making this year's event not only possible, but engaging and inspiring! The dedicated mentoring of undergraduate students in research, scholarship, and creative works is what makes this event a huge success each year.

Special thanks to our faculty moderators for running the Q&A sessions, University Copy for printing programs, University Operations for the space reservation and set up, Copley Library and Digital USD for publishing abstracts, and the staff at the Office of Undergraduate Research--Andrea Machado, Jennyfer Amezcua, and Viviana Vidrio--for their enthusiasm and commitment to putting the entire event together from start to finish.

Major support for the Creative Collaborations Undergraduate Research Conference and OUR operations come from the Office of the Provost and Vice President for Academic Affairs. We'd like to also acknowledge the Office of the Vice President of Student Affairs, the Office of the Vice President for University Advancement, other campus leaders and partners for their support of undergraduate research. Finally, the research conducted by the students would not be possible without generous donors and foundations.

## SUPPORT UNDERGRADUATE RESEARCH

Interested in making a gift for undergraduate research? Use the QR code below!

Your support matters and will:

- Expand access to funded research opportunities for students
- Strengthen faculty mentorship through equitable support
- Enhance research communication through travel support to conferences
- Ensure USD remains a leader in student-centered discovery and innovation

At USD, undergraduate research transforms curiosity into discovery, and discovery into impact. By investing in the next generation of researchers, your support fuels the ideas, innovations, and leaders of tomorrow.